

## Space Weather Status for Exploration Radiation Protection

Dan Fry<sup>1</sup>, Kerry Lee<sup>1,\*</sup>, Neal Zapp<sup>1</sup>, Janet Barzilla<sup>2</sup>, Audrey Dunegan<sup>2</sup>, Steve Johnson<sup>2</sup>,  
Nicholas Stoffle<sup>2</sup>

*(1) National Aeronautics and Space Administration (JSC), Houston, TX, USA*

*(2) Lockheed Martin (IS&GS-Civil), Houston, TX, USA*

Management of crew exposure to radiation is a major concern for manned spaceflight and will be even more important for the modern concept of longer-duration exploration. The inherent protection afforded to astronauts by the magnetic field of the Earth in Low Earth Orbit (LEO) makes operations on the space shuttle or space station very different from operations during an exploration mission. In order to experience significant radiation-derived Loss of Mission (LOM) or Loss of Crew (LOC) risk for LEO operations, one is almost driven to dictate extreme duration or to dictate an extreme sequence of solar activity. Outside of the geo-magnetosphere, however, this scenario changes dramatically. Exposures to the same event on the ISS and in free space, for example, may differ by orders of magnitude. This change in magnitude, coupled with the logistical constraints present in implementing any practical operational mitigation make situational awareness with regard to space weather a limiting factor for the ability to conduct exploration operations. We present a current status of developing operational concepts for manned exploration and expectations for asset viability and available predictive and characterization toolsets.

Key words (less than 5 words): Space Radiation, NASA, Space Operations